CHAPTER 5

CRITERIA FOR VARIOUS TYPES OF FACILITIES

5-1. General

This chapter presents criteria and design guidance specific to several types of facilities. This guidance complements the general criteria and design features presented in Chapter 4. Appendix C provides radioactive source considerations for each of the facilities presented in this chapter.

5-2. Power reactor

The potential for contamination in a power reactor facility is very great. Fission products released from containment failure of the sealed source can be carried throughout the coolant system. Leaks may have occurred. Neutron activation is very likely. General criteria for decommissioning reactors is covered in 10 CFR 50. The following recommendations are made.

a. Decommissioning Methods. Due to the long-lived activation products produced both in the materials of construction of the reactor and the surrounding bioshield, ENTOMB should not be considered a viable decommissioning alternative. Therefore, the design of the nuclear power supply system should facilitate its total removal either immediately following defueling through DECON or following some limited decay period through SAFSTOR.

b. Materials. Materials that are less susceptible to activation should he used. Alternatively, use materials that, when activated, produce a lower radiation field than conventional construction materials. Avoid construction materials that produce gaseous radioactive activation or decay products. Examples of this approach are as follows:

(1) The use of zircaloy in place of stainless steel for some reactor internals.

(2) The use of heavily borated concrete. The boron captures the neutrons and prevents the generation of normal concrete activation products. The boron capture does produce tritium which is long lived and emits a low energy beta. The resulting radiation levels are much lower than those normally encountered from activated concrete.

c. Component Assembly. Use construction methods and systems and equipment components wherever possible which can be easily dismantled to minimize demolition of the facility. Examples are as follows:

(1) Equipment arrangement should facilitate removal with the fewest number of cuts and, if possible, as complete components.

(2) Bulk or mass shielding walls should be designed as interlocking segments that can be placed and removed using a crane.

(3) The spent fuel pool should be designed to facilitate underwater segmenting of radioactive components. Since all fuel will be removed from the facility prior to the initiation of any decommissioning option, the spent fuel pool will not be required. With the fuel racks removed, an adequate quantity of shielding water could be maintained over very radioactive components requiring segmenting. Provisions that could be made to allow the spent fuel pool to be used for segmenting components are:

(a) The installation of, or provisions for the installation of, materials handling equipment.

(b) Sizing of the spent fuel pool to ensure it can accept components for segmenting.

5-3. Research reactors and accelerators

The DECON method of decommissioning is the preferred method for such facilities. Therefore, these research facilities should be designed to facilitate their total removal following defueling or termination of facility operation. The guidance given above for power reactors related to DECON is basically applicable, with a few obvious exceptions, and should be followed when considering design of research facilities. General criteria for decommissioning research reactors is provided in 10 CFR 50 and criteria for accelerators is provided in 10 CFR 30.

5-4. Radiographic facilities

Radiographic Facilities are utilized to non-destructively examine items for defects and foreign material. Radiography may be conducted using electromagnetic radiation or neutron sources. General criteria for decommissioning radiographic facilities is provided in 10 CAR 30. The following recommendations are made:

a. Source. Radiographic facilities are designed based on an assumption that only sealed radiographic sources are present at the facility. It is important that the source remain sealed. The quality of the source containment and appropriate care in handling are imperative in reducing the risk of spread of contaminants while using the radiographic source.

b. Maintenance. Design features that should be addressed are those that would permit frequent and easy checking of the sealed source in order to ensure the integrity of the seal. Checking of the sealed source should be able to be performed in an ALARA manner. The potential for neutron activation when using a neutron source must be considered.

5-5. Facilities for depleted uranium munition

Munitions and projectiles with depleted uranium (DU) components are test proven in practice firings. Fragments of the tested component and radioactive dust particles liberated during impact with targets will be generated during testing. General criteria for decommissioning DU facilities is provided in 10 CFR 40. This type of facility is currently in operation at Aberdeen Proving Ground, Maryland. It is recommended that a review of the design, construction, and operation of this facility be made prior to initiation of a new facility design.

a. Structural Features. Testing should be conducted whenever possible in enclosed facilities with air handling and filtering capabilities to prevent release of contaminants to the outside. The explosive yield involved in the test may make indoor testing impractical. The following structural features are recommended for a test cell:

(1) The interior surfaces shall be coated with impermeable, non-combustible and sealed material. Radioactive dust and particle settlement will be washed and collected for disposal.

(2) The coatings used on cell walls and floors should not present a fire hazard during testing. Explosion tests release significant amounts of heat which can cause combustible wall coatings to burn.

(3) A concrete floor slab design is preferred over a concept which includes covering the floor with one to two feet of gravel. If gravel material is used, design to allow access for removal and disposal of the gravel which will be contaminated.

b. Holding Tanks. Holding tanks used to collect wash-down from the target facility should be above grade. Containment of accidental spills should be provided.

5-6. Research, development, testing and medical laboratory facilities

General criteria for decommissioning research development and testing facilities is provided in 10 CFR 30,40, and 70, and general criteria for medical laboratories is provided in 10 CFR 30. The following design recommendations are made:

a. Work Stations. Counter tops should be designed to contain spills and prevent loss off the counter. The counter top design should, in particular, prevent radioactive liquids from seeping between the counter and wall. A sealed perimeter lip to contain spills is appropriate. Nonporous, impermeable materials should be used on work surfaces. Work stations shall be modular to allow removal and disposal of contaminated units.

b. Hoods. Laboratory hoods should be stainless steel rather than fiberglass. The hood flow rate should be great enough to ensure turbulent flow.

c. Surfaces. Counters, walls, floors, or any surface on which contaminants could collect should be nonporous, sealed, lined, or coated in order to prevent the migration of contaminants into the materials of construction and to facilitate the cleanup of these surfaces.

d. Glove Boxes. For facilities requiring glove boxes, the following design criteria should be considered:

(1) Glove boxes should be provided with collection systems to handle spills and leaks.

(2) Service lines must be designed so that they do not provide a leak path.

(3) Glove boxes should be sized to facilitate their disposal or rearrangement.

(4) Glove boxes shall be designed so that they are easy to separate.

(5) Pipes, ducts, conduits, or other attachments to the glove box shall be easy to disconnect.

(6) The glove box should be designed for ease of decontamination inside and out.

(7) Glove boxes should have lighting fixtures which are flush with the top of the glove box and sealed.

(8) Glove boxes should have rounded edges.

(9) Enclosed conveyors should be used to connect long glove box segments.

(10) Enclosed conveyor systems should be connected to glove boxes in a manner to facilitate easy removal.

(11) Glove boxes should have prefilters and HEPA filters on both the ventilation system inlets and exhaust.

(12) Glove boxes shall maintain a negative pressure for any activity involving the handling of radionuclides. This causes leakage through flaws to be directed into the box and prevents the spread of contamination.